DETAILED DESCRIPTION OF THE DRAWINGS AND SPECIFIC EMBODIMENTS

[0012] A patient coordinate system aligns medical scans across scanners and/or time. A shape model of the patient is stored along with medical images and scanner information, such as storing the shape model in the same Dicom file. The shape model relates the scan to the human anatomy instead of some arbitrary (scanner) coordinate system. The transformation between two scans is computed by bringing the shape models into alignment. The alignment is used for comparison and/or to guide scanning to scan the desired locations (e.g., find previously located lesions for comparison of size and/or shape).

[0013] Various shape models may be used. For example, with cameras becoming more prevalent in scanning or operating rooms, the reference shape models are outer surfaces of the patient from the camera. As another example, three-dimensional freehand ultrasound examinations use an organ surface (or part of an organ surface) or three-dimensional distribution of landmarks as the shape model. The shape model-based registration aligns coordinate systems without storage of a full three-dimensional scan. The shape model-based registration may guide ultrasound scanning to scan the same lesions without undue effort, such as requiring a few minutes to scan the same lesions instead of an hour hunting for and confirming a lesion of a subsequent scan as being the same lesion as seen in a previous examination.

[0014] Freehand-3D (or 3D freehand) ultrasound makes use of a transducer that captures planar images (or 3D images with a limited field-of-view) and puts them together in a volume with the help of tracking technology (e.g., optical or electromagnetic, possibly supported by images based approaches). The tracking system records the pose (position and orientation) of each single capture in a 3D volume. Often, freehand-3D is referred to simply as freehand, where tracking may not be used. As used herein, freehand includes freehand-3D. Freehand 3D ultrasound bridges the gap between 2D and 3D imaging, making use of an ultrasound transducer that yields 2D images and tracking pose (position and orientation) during the acquisition of a sequence of 2D images. The pose information then allows assembly of the individual 2D ultrasound slices into a 3D volume.

[0015] In one embodiment, the medical ultrasound imager three-dimensionally scans a volume of a patient during a first appointment according to the freehand-3D paradigm. A transducer acquiring 2D images is tracked with a suitable tracking technology (e.g. with a commercial optical or electromagnetic tracking system). The tracking system tracks the pose (position and orientation) of the transducer so that the individual 2D ultrasound images can be assembled in a 3D coordinate system, resulting in a spatially correct 3D representation of the scanned subject. A three-dimensional distribution derived from the scan data from the three-dimensionally scanning during the first appointment and one or more lesions represented by the scan data are determined. A two-dimensional image for the one or more lesions, the three-dimensional distribution, and a location or locations for the one or more lesions are stored. The volume of the patient is three-dimensionally scanned during a second appointment different than the first appointment. The three-dimensional distribution is registered with results from the scanning of the volume during the second appointment. Imaging of lesions after the 3D scanning during the second appointment is guided by the relating the pose of the current ultrasound image relative to the previously recorded location (s) of the one or more lesions.

[0016] FIG. **1** shows one embodiment of a method for aligning scans from different times with a medical imager. A patient coordinate system is used to align. A three-dimensional distribution of an object or objects of the patient is determined for each scan. The distribution is less than the full 3D volume or scan, such as being a surface. The distribution is stored with the results from the examination and later used to align with the distribution for a subsequent examination. The alignment allows for comparison of information from the different scans.

[0017] The method is implemented by a medical diagnostic imaging system, a review station, a workstation, a computer, a PACS station, a server, combinations thereof, or another device for medical imaging. A given scanner performs one or multiple scans of a patient. Different scanners of the same or different modalities (e.g., ultrasound, computed tomography (CT), magnetic resonance (MR), x-ray, positron emission tomography (PET), or single photon emission computed tomography (SPECT)) may perform the scans. A same scanner may perform the scan. A medical imager aligns the results of the scans based on patient-specific shape models. The medical imager performing the generating, storing, determining, comparing, and/or imaging may be one of the medical scanners or a separate server, review station, workstation, or computer. In yet other embodiments, a computer, server, or workstation obtains scan data from memory and a medical scanner is not provided.

[0018] The patient shape model alignment may be used in any modality of imaging or across modalities (e.g., align ultrasound with CT or MR). In one embodiment, the alignment provides guidance to scan locations of interest. This guidance may be useful for freehand ultrasound.

[0019] The method is implemented in the order shown or a different order. For example, act **14** occurs in between repetition of acts **10-12**.

[0020] Additional, different, or fewer acts may be performed. For example, act **20** is optional. As another example, act **10** is not performed, but instead scan data is acquired from memory. In yet another example, acts **10-12** are not repeated such as where acts **10-12** are performed for a subsequent examination, and the patient shape model from a previous examination is loaded from memory. In another example, act **18** is not performed.

[0021] In act **10**, a medical imager scans a patient at a first time. Any modality of medical imager may be used, such as CT, MR, x-ray, ultrasound, PET, or SPECT. The patient is positioned relative to the medical imager and/or the medical imager is positioned relative to the patient for scanning. Any type of scan may be used.

[0022] For scanning with an ultrasound scanner, an ultrasound transducer is positioned with acoustic contact to a patient. For scanning a volume of the patient, a volume scanning transducer (e.g., 2D array or multiple 1D array for MPR) or a 2D imaging transducer (e.g., 1D array) may be used. In freehand-3D scanning, a 1D array is translated while planes are imaged. Using a tracking system with a pose sensor, such as a magnetic position sensor, optical sensor, and/or transducer-based scan data, the position of the array and corresponding scan planes are determined, allowing assembly into a volume. The user may manually position